Turk J Anaesth Reanim 2014; 42: 257-63 DOI: 10.5152/TJAR.2014.75508

Original Article

Comparison of Spinal Anaesthesia and Paravertebral Block in Unilateral Inguinal Hernia Repair

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Abstract

Objective: We aimed to compare the efficacy of spinal anaesthesia (SA) and paravertebral block (PVB) in unilateral inguinal hernia repair.

Methods: Sixty American Society of Anesthesia physical status (ASA) I-III patients aged between 18-64 years with unilateral inguinal hernia were enrolled in this study. Two patients in Group SA and 4 patients in Group PVB were excluded, and statistical analyses were done on 54 patients. In regard to anaesthetic choice, patients were divided into two groups, with 30 patients in each: Group SA, spinal anaesthesia and Group PVB, paravertebral block. Standard monitoring was done, and mean arterial pressure (MAP) and heart rate (HR) were recorded during the surgical procedure. Demographic variables, surgical data, patient satisfaction, the onset times to reach T10 dermatome and to reach peak sensory level, and onset time to reach modified Bromage 3 motor block were recorded. Postoperative nausea and vomiting and pain at postoperative hours 0-24 with the visual analog scale (VAS) were also measured.

Results: Compared to pre-anaesthesia measurements, the decrease in HR and MAP during the 10^{th}-90^{th} minute period was significant in Group SA ($p<0.01$). In Group PVB, sensory block duration time was higher, whereas paralysis rate was higher in Group SA ($p<0.01$). Bromage scores were significantly different between the groups ($p<0.01$). In Group SA, VAS score at the 24^{th} postoperative hour, nausea, and vomiting were significantly higher compared to Group PVB ($p<0.01$).

Conclusion: In conclusion, paravertebral block provides acceptable surgical anaesthesia, maintaining good quality and long duration on postoperative analgesia in unilateral hernia repair.

Key Words: Paravertebral block, spinal anaesthesia, inguinal hernia

Introduction

Inguinal hernia repair can be performed using various anaesthetic methods alone or in combination and patient satisfaction can be provided. General anaesthesia and various regional anaesthesia methods are approved for inguinal hernia repair. The reasons for preferring regional anaesthesia methods include absence of unconsciousness, absence of respiratory depression, lower rates of postoperative nausea and vomiting, and more rapid recovery (1, 2).

Although spinal anaesthesia (SA) has the benefits of suppressing the stress response to surgical intervention, decreasing morbidity in high-risk patients, and enabling maintenance of analgesia in the postoperative period, cardiovascular system-specific adverse events such as arterial vasodilation, peripheral reflex vasoconstriction, bradycardia and hypotension may pose a problem (3, 4).

Paravertebral block (PVB) involves the unilateral administration of local anaesthetics to the nerve roots and related dermatomes without intervening central nervous system (5). This procedure allows avoiding the adverse effects of spinal anaesthesia and it is used as an alternative method in patients with unstable cardiovascular systems. In general patient population, it has been observed that recovery is rapid and returning to daily activities is faster in cases that underwent inguinal hernia repair under paravertebral block (6). Hadzic et al. (7) compared general anaesthesia and paravertebral block in cases that underwent inguinal hernia surgery and reported lower incidence of nausea, vomiting, sore throat and postoperative pain in the paravertebral block group.

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Received: 13.06.2013
Accepted : 24.10.2013
Available Online Date: 09.07.2014

Levobupivacaine, which is one of the local anaesthetics used in regional anaesthesia practice, is preferred by many anaesthesiologists as it provides better cardiovascular stability (8). It has been determined that using levobupivacaine in lower abdominal surgeries provides similar efficacy with other local anaesthetics and is safe (9). It was observed that it is successful in paravertebral block in terms of both efficacy and postoperative analgesia (10).

The present study aimed to evaluate the anaesthetic and postoperative analgesic efficacy of spinal and paravertebral block methods performed using levobupivacaine in unilateral inguinal hernia surgery.

Methods

After obtaining ethical approval (dated 12.01.2010 and decision No. 9) of Şişli Etfal Training and Research Hospital Ethics Committee, the cases were informed about the study in detail one day before the surgery and they signed the informed consent forms. A total of 60 American Society of Anesthesiologists physical status (ASA) class I-III patients aged between 18 and 68 years, who had been admitted to the general surgery clinic to be operated for unilateral inguinal hernia, were prospectively and randomly enrolled in the present study. Patients with a body weight 20% higher than ideal body weight, those with liver disease, allergy to anaesthetic agents, local infections and history of receiving anaesthesia until the last two weeks were excluded.

The cases were randomly divided into two groups by closed envelope method. Group SA (n=30): in this group, which received spinal anaesthesia, the patient was placed in left or right decubitus position on the operating table; subarachnoid space was accessed by 22 gauge spinal needle (B. Braun, Germany) under spinal anaesthesia and 4 ml of 0.5% levobupivacaine was injected within 30 seconds. The patient was placed in supine position immediately after spinal block and procedure was started after verifying that the sensory block was at T_{10} dermatome level.

Group PVB (n=30): in this group, which paravertebral block was used, the patient was placed in prone position in the operating room. The right or left transverse processes and vertebral bodies consistent with the hernia site were identified and the spinal processes of vertebras between T_9 and L_1 were marked at 3 cm distant from the vertebral body. Under sterile conditions, 1 mL of 2% lidocaine was injected subcutaneously. Thereafter, transverse processes at each level was found at 4-5 cm depth using 22 gauge stimuplex needle (UniPlex NanoLine cannula, Pajunk®, Germany) and then 4 mL of 0.5% levobupivacaine was injected after fasciculations were triggered at the abdominal rectus muscle, consistent with the dermatome by 1.5 mA (Pajunk, Geisingen, Germany) stimulation, and muscular response was obtained even to 0.5 mA stimulation. The level of anaesthesia was verified by pin prick test and then the patient was turned over to the surgical team.

Premedication was performed in all cases using 3 mg intravenous midazolam and 1000 cc of crystalloid. In the operating room, the cases underwent routine monitoring including electrocardiography (ECG), SPO_2 and non-invasive blood pressure until the end of the surgery. Both preoperative and intraoperative mean arterial pressures (MAP) and heart rate (HR) of the cases were recorded at 5-minute intervals for the first 15 minutes and then at 30-minute intervals until the end of surgery. Height, weight, gender, ASA class, duration of anaesthesia and surgery, and patient satisfaction immediately after and 24 hours after the surgery were recorded. Maximum level of motor block and sensory block, time to reach to T_{10} dermatome, time to reach to maximum block height, and time to complete recovery from sensory block and motor block were recorded. Degree of motor block was assessed by Bromage score (0=no paralysis, 1=able to move only knees and feet, 2=unable to flex the knee but moves the feet, 3=total paralysis) and postoperative pain score was assessed by visual analogue scale (VAS) with 0 is the lowest and 10 is the highest scores. The patient was also monitored for nausea and vomiting. Patient satisfaction was questioned both immediately after and 24 hours after the surgery and was recorded as excellent, good and poor. The day before surgery, the case was informed about the scoring method and the scale that would be used.

The patients that developed hypotension (mean arterial pressure <70 mmHg) received intravenous fluid (0.9% NaCl) replacement and/or 5 mg of ephedrine, whereas 0.5 mg IV atropine was administered in the event of bradycardia (HR <50/min). Necessary data were recorded by the anaesthesiologists and relevant anaesthesia technician during the procedure. The cases that were admitted to the postoperative recovery room were kept in the recovery room for two hours and then transferred to the General Surgery ward. VAS and nausea-vomiting scores as well as all adverse events encountered within 24 hours (e.g., arrhythmia, pruritus, erythema, headache, and urinary retention) were recorded at postoperative 0, 2, 4, 6, 12, and 24 hours.

In the event of a VAS score ≥4, diclofenac sodium at a dose of 75 mg was given; if pain persisted 50 mg of meperidine was administered via intramuscular route. Metoclopramide was given if nausea-vomiting was observed; in case metoclopramide was inadequate, granisetron ampoule was administered via intravenous route.

Statistical analysis

NCSS 2007&PASS 2008 Statistical Software (Utah, USA) program was used for all statistical analyses in the study. While evaluating study data, in addition to descriptive statistics (mean, standard deviation, median, ratio, frequency), Student t-test was used for inter-group comparison of parameters with normal distribution; whereas paired t-test was used for intragroup comparisons. Inter-group comparisons of parameters that did not show normal distribution was done

using Mann-Whitney U test; whereas intragroup comparisons were done using Wilcoxon-Signed Rank test. For the comparison of qualitative data, Fisher-Freeman-Halton test was used for 2xN contingency table and Fisher's Exact test was used for 2x2 contingency table. P<0.05 was considered significant for all analyses. The power analysis performed according to the time of discharge from hospital, revealed that by setting alpha = 0.05 and (1-β), a sample size of 30 for each group was sufficient to achieve a power of 80%.

Results

The study was carried out in a total of 60 cases; however, a total of six cases were excluded from analysis as the level of spinal block remained below T_{10} in two cases that underwent spinal anaesthesia; whereas, anaesthesia could not be achieved in L_1 dermatome in one, perioperative pain developed in two, and anxiety developed during block in one of four cases that underwent paravertebral block. Consequently, a total of 54 cases, 28 in Group SA and 26 in Group PVB, completed the study.

No significant difference was determined between the two groups in terms of age, height, weight, mean surgery duration, gender, and distribution of ASA grades.

There was no significant difference between the two groups in terms of intervention time and time to reach to T_{10} dermatome. Time to recovery of sensory block was found to be significantly longer in Group PVB in comparison to that in Group SA (p=0.009). Bromage scores were significantly different between the groups (p=0.001); the incidence of absence of paralysis was higher in Group PVB and the incidence of total paralysis was higher in Group SA (Table 1).

Percentage changes in MAP before block and at 5, 60 and 90 minutes after block showed no statistically significant difference between the groups. Compared to the values before block, the level of decrease at 10, 15 and 30 minutes after block was found to be significantly higher in Group SA than that observed in Group PVB (p=0.006; p=0.024; and p=0.032, respectively). Significant differences were determined between the groups in terms of HR measurements before block (p=0.003). While, percentage changes calculated for HR before block and at 5, 60 and 90 minutes after block showed no statistically significant difference between the groups, compared to the values before block, the decrease at 10, 15 and 30 minutes after block was significantly higher in Group SA than that observed in Group PVB (p=0.012; p=0.001; and p=0.019, respectively) (Table 2).

Intragroup analysis of MAP measurements before block and changes in the 15th, 30th, 60th and 90th minutes after block showed statistically significant difference. Statistically significant decreases were determined in the values measured after block and before block in Group SA (p=0.002; p=0.001). Heart rate was found to be significantly higher before block and in the 10th, 15th, 30th, 60th and 90th minutes after block in Group SA (p=0.001) and in the 10th, 15th, 30th and 60th minutes after block in Group PVB (p=0.047; p=0.011; p=0.043; and p=0.042) (Table 3).

VAS scores at postoperative 0, 2, 4, 6 and 12 hours showed no significant difference between the groups; VAS score in

Table 1. Comparison of demographic characteristics and peri-operative variables of paravertebral block and spinal anaesthesia groups

		Group PVB (n=26)	Group SA (n=28)	p
Age (years); Mean±SD		44.61±16,0	40.96±15.69	0.402[1]
Height (cm); Mean±SD		171.89±5,76	172.0±8.21	0.956[1]
Body weight (kg); Mean±SD		72.86±6.80	74.04±9.0	0.587[1]
Gender; n (%)	Male	25 (96.2)	25 (89.3)	0.61[2]
	Female	1 (3.8)	3 (10.7)	
ASA; n (%)	1	20 (71.4)	1 9(73.1)	0.43[3]
	2	7 (25)	4 (15.4)	
	3	1 (3,6)	3 (11.5)	
Duration of surgery (min); Mean±SD		80.0±20.78	87.68±29.74	0.280[1]
Time to reaching to T_{10} (min); Mean±SD		18.65±5.93	15.21±9.37	0.111[1]
Time to recovery of sensory block (hour) median (min-max)		6 (4-9)	5 (3-8)	0.009[4]
Bromage score; n (%)	No paralysis	26 (100%)	2 (7.1%)	0.001[3]
	Unable to flex the knee, moves the feet	0 (0%)	8 (28.6%)	
	Total Paralysis	0 (0%)	18 (64.3%)	

[1]Student t test, [2]Fisher's Exact test, [3]Fisher-Freeman-Halton test, [4]Mann-Whitney U test; SD: standard deviation; min: minimum; max: maximum; PVB: paravertebral block; SA: spinal anaesthesia; ASA: American Society of Anaesthesiology physical status

Table 2. Baseline values of mean arterial pressure and heart rate and percentage changes in the other measurement time points compared to baseline in the paravertebral block and spinal anaesthesia groups

	MAP			HR		
	Group PVB (n=26)	**Group SA (n=28)**	**[1]p**	**Group PVB (n=26)**	**Group SA (n=28)**	**[1]p**
Before block; Mean±SD	96.5±21.31	101.93±13.61	0.266	68.85±10.02	78.89±13.21	0.003
	Median (min/max)	**Median (min/max)**	**[2]p**	**Median (min/max)**	**Median (min/max)**	**[2]p**
% change at 5 minutes versus before block	-2.71 (-25.2/28.38)	-4.77 (-27.78/13.25)	0.182	-2.07 (-12.31/13.16)	-5.83 (-37.84/63.64)	0.109
% change at 10 minutes versus before block	-1.79 (-15.73/36.49)	-10.29 (-43.48/12.05)	0.006	-5.95 (-18.92/21.43)	-12.49 (-39/17.28)	0.012
% change at 15 minutes versus before block	-1.32 (-21.38/43.33)	-10.91 (-41.96/12.05)	0.024	-4.87 (-32.43/21.05)	-15.34 (-49.52/6)	0.001
% change at 30 minutes versus before block	-2.25 (-34.48/38.33)	-9.09 (-38.39/5.75)	0.032	-7.06 (-25.37/34.38)	-16.67 (-46.67/15.12)	0.019
% change at 60 minutes versus before block	-4.03 (-100/43.33)	-10.56 (-100/14.81)	0.245	-10.56 (-100/21.67)	-19.67 (-100/20)	0.071
% change at 90 minutes versus before block	-62.31 (-100/45)	-100 (-100/17.24)	0.351	-58.46 (-100/16.67)	-100 (-100/14)	0.142

[1]Student t test, [2]Mann-Whitney U test; SD: standard deviation; min: minimum; max: maximum; MAP: mean arterial pressure; HR: heart rate; PVB: paravertebral block; SA: spinal anaesthesia

Table 3. Intragroup measurements of mean arterial pressure and heart rate in the other measurement time points compared to baseline in the paravertebral block and spinal anaesthesia groups

	MAP		HR	
MAP	**Group PVB (n=26)**	**Group SA (n=28)**	**Group PVB (n=26)**	**Group SA (n=28)**
Before block	96.5±21.31	101.93±13.61	68.85±10.02	78.89±13.21
5 minutes after block	93.77±19.95	94.75±13.27	67.27±9.38	74.18±12.88
10 minutes after block	96.42±19.12	88.86±13.50	66.08±10.33	69.46±11.47
15 minutes after block	95.81±16.79	88.36±12.76	64.81±11.54	65.00±9.67
30 minutes after block	95.08±14.71	90.14±10.94	65.15±12.57	66.50±12.24
60 minutes after block	96.86±16.08	92.13±11.81	65.33±11.49	65.83±10.98
90 minutes after block	93.62±9.72	96.83±13.54	65.84±9.67	64.75±12.42
Significance (p)				
5 minutes vs. before block	0.148	0.729	0.072	0.034
10 minutes vs. before block	0.974	0.340	0.047	0.001
15 minutes vs. before block	0.148	0.002	0.011	0.001
30 minutes vs. before block	0.974	0.001	0.043	0.001
60 minutes vs. before block	0.832	0.001	0.042	0.001
90 minutes vs. before block	0.690	0.001	0.483	0.001

Paired t test, SD: standard deviation; MAP: mean arterial pressure; HR: heart rate; PVB: paravertebral block; SA: spinal anaesthesia

the postoperative 24th hour was statistically significantly higher in Group SA as compared to Group PVB (p=0.001) (Table 4). Changes in VAS scores at 2, 4, 6 and 12 hours from baseline showed no statistically significant difference between the groups; level of decrease at 24 hours from baseline was significantly higher in Group SA (p=0.001) (Table 5).

While none of the cases in Group PVB developed nausea at any time point, two cases (7.2%) at 0 hour, 10 cases (35.6%) in the 2nd hour, and one case each (3.6%) at 6, 12 and 24 hours developed nausea in Group SA. The difference between the groups in terms of incidence of nausea was statistically significant only in the 2nd hour (p=0.001).

Table 4. Baseline scores of Visual Analogue Scale (VAS) and differences in VAS scores in other measurement time points in comparison to baseline in paravertebral block and spinal anaesthesia groups

	Group PVB (n=26)	Group SA (n=28)	[1]p
0 hour; median (min-max)	0 (0-4)	0 (0-5)	0,482
	Median (min/max)	**Median (min/max)**	**[2]p**
Difference in score at 2 hours compared to baseline	0 (-3/2)	0 (-5/2)	0.540
Difference in score at 4 hours compared to baseline	0 (-3/6)	0 (-5/2)	0.187
Difference in score at 6 hours compared to baseline	0 (-1/6)	0 (-5/6)	0.737
Difference in score at 12 hours compared to baseline	1 (-2/8)	2 (0/6)	0.147
Difference in score at 24 hours compared to baseline	0 (-4/5)	2 (0/6)	0.001

[1]Mann-Whitney U test, [2]Wilcoxon Signed Rank test; min: minimum; max: maximum; PVB: paravertebral block; SA: spinal anaesthesia

Table 5. Visual Analogue Scale (VAS) Scores at other measurement time points compared to baseline in the paravertebral block and spinal anaesthesia groups

	Group PVB (n=26)	Group SA (n=28)
0 hour; median (min-max)	0 (0-4)	0 (0-5)
2 hours; median (min-max)	0 (0-2)	0 (0-6)
4 hours; median (min-max)	0 (0-6)	0 (0-3)
6 hours; median (min-max)	0 (0-6)	0 (0-6)
12 hours; median (min-max)	2 (0-8)	5 (0-6)
24 hours; median (min-max)	1 (0-5)	4 (0-6)
Significance (p)		
Difference in score at 2 hours compared to baseline	0.216	0.496
Difference in score at 4 hours compared to baseline	0.082	0.952
Difference in score at 6 hours compared to baseline	0.035	0.130
Difference in score at 12 hours compared to baseline	0.002	0.001
Difference in score at 24 hours compared to baseline	0.079	0.001

Wilcoxon Signed Rank test; min: minimum; max: maximum; PVB: paravertebral block; SA: spinal anaesthesia

Patient satisfaction either just after the surgery or 24 hours later showed no significant difference between the groups (p=0.596; p=0.791).

In the perioperative period and in postoperative 24 hours, one case developed tachycardia, four cases developed headache and two cases developed urinary retention in Group SA, whereas application site erythema and pruritus was observed in a single case in Group PVB.

Discussion

In the present study, comparing paravertebral block with spinal anaesthesia in the patients that underwent unilateral inguinal hernia repair, it was determined that adequate anaesthesia was achieved with paravertebral block during the procedure and the patient remained haemodynamically stable, postoperative adverse events were minimal, and it is a preferable anaesthesia method because of prolonged analgesia.

Being inspired by their experiences on paravertebral block that they used to reduce chronic pain in breast surgery, Weltz et al. (6) started using lumbar paravertebral block for inguinal hernia surgeries. They thought that paravertebral block would be preferred due to prolonged sensory block characterized by minimal postoperative pain and lower use of narcotics, lower incidence of nausea and vomiting, and shorter hospital care requirement. Hadzic et al. (7) confirmed these findings by comparing paravertebral anaesthesia with general anaesthesia in the cases that underwent inguinal hernia repair. In the present study as well, prolonged analgesia was provided in the group that received paravertebral anaesthesia and the incidence of nausea and vomiting was lower.

Naja et al. (11) compared the efficacy of bilateral paravertebral block and mild sedation with that of general anaesthesia in ventral hernia surgeries and determined that paravertebral block was more effective. In the present study as well, it was determined that the surgery could be performed under mild sedation with paravertebral anaesthesia in cases undergoing unilateral inguinal hernia repair.

In another study, Naja et al. (12) compared paravertebral block performed with the help of a nerve stimulator with ilio-inguinal nerve block in children that underwent herniorrhaphy. The two methods were compared in terms of intraoperative haemodynamic stability, postoperative pain scores at rest and during activity, requirement for additional analgesics, and parent satisfaction and it was determined that paravertebral block was superior to ilio-inguinal nerve block. The cases first underwent general anaesthesia and then received regional anaesthesia. Paravertebral block was performed in the cases through three different levels as T_{12}-L_1, L_1-L_2 and L_2-L_3, and the local anaesthetic drug was injected after observing muscle movements at the related level by a nerve stimulator. In the present study as well, we injected the local anaesthetic after observing muscle movements related to the relevant der-

matome using a nerve stimulator. However, we performed injection through 5 levels between T_9 and L_1 since the adult patients included in the study only received mild sedation. Based on our observations, the most important dermatomes that should be blocked correspond to T_{12} - L_1 levels, where the surgical team that would perform inguinal hernia surgery works most. In order to achieve complete anaesthesia in lower dermatomes in the beginning of the surgery, anaesthesia should start from lower levels and continue to the upper levels.

Klein et al. (13) compared paravertebral somatic nerve block and peripheral nerve block in outpatient surgery practices for inguinal herniorrhaphy; after general anaesthesia, they performed paravertebral block at T_{10}-L_2 level in the first group, ilioinguinal hypogastric nerve block (IHNB) in the second group, and local anaesthesia to the skin and subcutaneous tissues of the incision site in the third group. The incidence of nausea and vomiting and opioid use during and after surgery was found to be lower in cases that underwent paravertebral block, although no significant difference was determined in terms of time to onset of pain. Wassef et al. (14) determined that paravertebral block was superior to incisional block. We, as well observed that paravertebral block enhanced both perioperative and postoperative patient comfort regarding anaesthesia and favourably influenced the quality of analgesia.

Özkan et al. (15) conducted a study comparing 2-segment and 4-segment paravertebral block in inguinal hernia surgeries and concluded that 2-segment paravertebral block might be an alternative to 4-segment paravertebral block. Mandal et al. (16) suggested that 2-segment paravertebral block at T_{10} and L_1 could be an alternative to unilateral spinal anaesthesia owing to early mobilization and prolonged analgesic efficacy. These studies support the trials performed to adopt outpatient anaesthesia method in inguinal hernia surgeries and to shorten the duration of hospital stay, in general. Due to the unintended effects of general anaesthesia such as difficulty in recovery and airway suppression, and possibility of haemodynamic instability, high incidence of nausea and vomiting and postoperative headache by spinal anaesthesia, alternative anaesthesia methods are being investigated. In the present study, we observed that particularly T_{12} and L_1 levels should be blocked in paravertebral block and, however, the case felt discomfort and pain during perioperative peritoneal retraction in the event anaesthesia could not be achieved at T_9, T_{10} and T_{11}. On the other hand, it was determined that the risk of urinary retention and the duration of hospital stay, as well as the need for analgesics, were lower in the patients that underwent paravertebral block (17, 18).

The reasons affecting why it remains outside the routine practice despite all these favourable outcomes include, no doubt, the requirement of higher numbers of punctures and time. However, it should be kept in mind that it can be used particularly in cases with high ASA class and that might have problems in perioperative haemodynamic stability and need postoperative intensive care.

Conclusion

It is concluded that paravertebral block might be an alternative to spinal anaesthesia method in inguinal hernia surgery as it provides adequate anaesthesia during perioperative period and high quality analgesia during the postoperative period.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Şişli Etfal Training and Research Hospital (12.01.2010, No: 9).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - C.T.I.; Design - C.T.I., A.S.Ö.Ç.; Supervision - A.S.Ö.Ç., S.O.; Funding - C.T.I., R.G.I.; Materials - R.G.I.; Data Collection and/or Processing - C.T.I., R.G.I. Analysis and/or Interpretation - A.S.Ö.Ç., S.O.; Literature Review - C.T.I.; Writer - C.T.I.; Critical Review - A.S.Ö.Ç., S.O.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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